Yield of Crested Wheatgrass Following Release from Sagebrush Competition by 2,4-D.[1]

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Highlight

Rate of increase in yield of crested wheatgrass following use of herbicide on associated sagebrush was measured over four years, including the year of treatment. Significant increases in yield, which were probably worthwhile economically, did not begin until the third year after spraying.

Fear of recovery by sagebrush (*Artemisia tridentata*) has long been one of the deterrents to undertaking reseeding projects on depleted sagebrush ranges. Various levels of competition by sagebrush have been shown to curtail production by many associated species, including crested wheatgrass (*Agropyron desertorum*) and native forages (Robertson, 1947; Robertson et al., 1966).

Herbicides have proved to be a good tool for quick renovation of grassed ranges rendered unproductive by sagebrush competition. The rate and magnitude of increased production by crested wheatgrass after application of herbicide is the subject of this study.

Methods of economic evaluation of crested wheatgrass range at different imputs and assumed returns have been published by Caton and Beringer, 1960; Gary et al., 1965, and Wagstaff, 1968.

The help of Glen Fulcher, formerly of the Division of Agricultural Economics, in initiating this study is gratefully acknowledged.

Methods

An allotment in Paradise Valley, Nevada, seeded in 1952, and supporting a dense stand of sagebrush with an understory of suppressed crested wheatgrass was selected for aerial spraying in 1960 by the Bureau of Land Management. Sagebrush formed a 12% canopy cover, by ocular estimation, before the spraying. This particular project area has been described by Cloward and Fulwider, 1955, and Eckert et al., 1961. The conditions which favored the sagebrush after seeding have also been published (Bleak & Miller, 1955).

Grazing by cattle between mid-April and mid-June was begun in 1955 and continued through the study period of 1960–1963, except in 1961. Fall and winter use was practiced in several years. Before spraying, cattle grazed the field 18 April to 10 May and again afterward, 10 to 15 June.

Prior to spraying, 33 pairs of cages were placed at 0.2-mile intervals along four transects (Robertson, 1954). Sampling bias was reduced by driving a truck along the transect and heaving a hammer over the cab from the right window to the left side. The hammer head marked the center of one 9.6 ft^2 plot. Another plot was selected near-by for similarity in botanical composition. The two were caged against grazing. One was selected by lot to be protected from the herbicide by a sheet of plastic film. Spraying was done between 17 and 29 May, 1960. Two pounds of low volatile ester 2,4-D was applied in diesel oil at 5 g.p.a. The cost was \$2.63/acre (Moore, 1968). Another similar project by the Bureau of Land Management was accomplished nearby for \$1.67/acre in 1961.

In order to test the response of the grasses to continuous spring grazing from the time of spraying and also to measure the differences in production under deferred grazing, alternate pairs of plots along the transects were designated for three clippings per season. The others were to be harvested only at maturity the first and second years, and three times the third and fourth. However, it was possible to maintain only 15 pairs of usable plots throughout four years because of partial survival of brush in some of the sprayed plots and disturbance of a few cages by cattle.

Clippings were in mid-to-late April, again in mid-May, and last in late July and early August if regrowth was present. Crop-year precipitation, October through June, was below normal during the four years, increasing annually from 6.6 in 1960 to 8.0 inches in 1963 (Table 1).

Results

Single harvests at maturity in 1960 and 1961 did not show any significant difference in yield associated with brush mortality. This was true not only of crested wheatgrass but also of two native perennials, Sandberg bluegrass (*Poa secunda*) and squirreltail (*Sitanion hystrix*) as well as the invading annual cheatgrass (*Bromus tectorum*).

Sprayed plots clipped three times the first year, 1960, yielded 143 lb/acre of crested wheatgrass, 17 lb less than those with live brush. In 1961 the same sprayed plots, cut three times, edged ahead of the controls 283 to 237 lb/acre (n.s.).

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Table 1. Mean yields of crested wheatgrass, o.d. basis, on sprayed and control plots during four years, 1960 to 1963.

Treatment or item	Year 1	2	3	4
Three cuts annually (n = 6)				
Sprayed	143	285	615	1163**
Control	160	245	422	603
One cut annually (n = 9)				
Sprayed	291	356	502[1]	798[1]
Control	265	336	458[1]	658[1]
Precipitation[2]	6.6	6.8	7.3	8.0

** Significant at the .01 level of probability.

[1] Same plots, three cuts annually (n = 9).

[2] Crop-year precipitation (inches), October through June. Mean of 30 years record = 8.16 inches.

Sprayed plots clipped three times continued each year to show a steadily increasing advantage over the controls. In the last year of measurement, the difference of 95% attributed to treatment was highly significant by the "t" test.

The series of paired plots clipped only at maturity the first and second year, and three times annually during the third and fourth showed a small, consistent but non-significant superiority in yield. Simulated deferment of grazing appeared to benefit the wheatgrass in the control plots, when compared with repeatedly clipped controls of the other series. This may account in part for the smaller treatment differences.

The data do not indicate that two years of deferment are essential after spraying sagebrush in crested wheatgrass. Good recovery from competition by sagebrush was evident despite frequent clipping of the wheatgrass.

Upward trend in growing season precipitation was paralleled by annual yields of grass, the effect being more pronounced in the sprayed plots (Table 1).

Conclusions

The management system will be a strong determinant of rate and amount of increase in production after spraying. It may easily be the critical factor in assessing economic feasibility of this range improvement practice in any particular instance.

In this example one treatment series outyielded it controls only 140 lb three years after spraying. The difference in the second series was 560 lb. Whether either of these differences or their mean, 350 lb, is accepted, the following equation may be used to estimate cost of producing an additional AUM (animal unit month) of grazing over a period of years.

$$\text{Cost/AUM} = \frac{\text{cost/acre} + \text{interest} \div \dfrac{\text{lb/yr increased forage} \times \%\ \text{P. U.}}{\text{AUM allowance}}}{\text{Anticipated life of improvement}}$$

Interest = Total payment–principal

Total payment = loan $\times$ amortization interest rate $\times$ years

For example, if we use \$2.63/acre, 5% interest, 350 lb/acre/yr increase

$$\text{Cost/AUM} = \$2.63 + \$1.59 \div \frac{(350)\quad(.80)}{600} = \$0.45$$

Interest = \$4.22 – \$2.63 = \$1.59

Total payment = (\$2.63) (.0802) (20) = \$4.22

Eighty percent utilization (P. U.) of crested wheatgrass, 20 years amortization, and 600 lb/AUM forage allowance are suggested as reasonable criteria on the basis of examples in the Intermountain Region.

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